

IX.—On some External Characters of Ruminant Artiodactyla.—Part VII. Domesticated Cattle (*Bos taurus* and *B. indicus*)*. By R. I. ПОЦОК, F.R.S.

I. INTRODUCTION.

The question of the origin of domesticated cattle has an extensive literature. The latest volume on the subject known to me was published in 1912 by the late Mr. Lydekker and entitled 'The Ox and its Kindred.' In this the views of previous writers are collated and analyzed, and accepted or rejected as the case may be, the general conclusions arrived at being apparently the following:—

1. Domesticated cattle are descended from two distinct species, one of which (*B. taurus*) is represented in its purest form at the present time by Pembroke, Kerry, West Highland, and British Park breeds, the other (*B. indicus*) by the breeds of zebus or humped cattle of India and elsewhere.
2. The extinct aurochs (*B. primigenius*) was the ancestor of *B. taurus*.
3. The existing banteng (*B. banteng*) was the ancestor of *B. indicus*, a theory originally propounded by Rüttimeyer in 1878 and supported by Keller in 1902 †.
4. The existence in the southern and some other countries of Europe of cattle partaking of the characters of *B. taurus* and *B. indicus* is due to the introduction of

* The substance of this paper was drafted in 1912 in the form of a review when Mr. Lydekker's volume, 'The Ox and its Kindred,' first came into my hands; but its publication was delayed for a variety of reasons, including my own occupation with other work and my friend's subsequent illness and death. Resumption of work upon the Ruminantia induced me to take up the paper again and cast it in its present form. Although compelled to criticise some inconsistent arguments and theories and dispute a few statements of fact it contains, I must disclaim all intention of disparaging this volume as a whole. It is a valuable compilation, containing in a handy form most of the information about cattle, useful to zoologists and laymen, that could be compressed into the allotted space.

† It is singular that Mr. Lydekker omits all reference to *B. indicus* in his 'Catalogue of Ungulate Mammals,' published in 1913. According to his views this form should have found a place under the subgenus *Bibos*. Perhaps the reason for its omission is that it possesses none of the characters of that group. It may be noted that if the opinion of the descent of *indicus* from *banteng* be true, *indicus* differs not merely specifically, but subgenerically, according to Lydekker, from *taurus*.

the latter into Europe and its subsequent interbreeding with the former.

Proposition 2 may pass as probably true*. Proposition 3 appears to me to be equally probably untrue; while propositions 1 and 4 are open to dispute in the sense that they are founded on facts susceptible of other interpretations.

II. THE BANTENG-DESCENT OF THE ZEBU.

Criticising this theory first of all from the ethnological, and admittedly therefore from a purely theoretical, standpoint, it appears to me improbable that a species domesticated by the Javanese belonging to the Malay stock of the Mongolian race of man was the ancestral form of the cattle of the people of India who belong to a different race. More likely does it seem that the ancestors of modern humped cattle were brought to India by invaders entering the country by way of the Punjab and Sind, unless an autochthonous species, now extinct as a wild animal, was found ready to hand for the purpose in India itself.

There are reasons for believing that the humped cattle have been a domesticated type for a very long time, certainly for a few thousand years B.C. So far as I am aware, there is no evidence, one way or the other, of the antiquity of the banteng as a domesticated animal; but if Rütimeyer's theory, supported by Keller and Lydekker, that the banteng was the ancestor of the zebu be true, its domestication must be assigned to a much earlier date to account for the acquisition of the distinctive peculiarities of the zebu. Yet, if this be so, it is surely strange that the domesticated banteng of Java and Bali differs in no important points from wild members of the species, still found in Java and Further India. This fact appears to me to be strongly suggestive of the conclusion that the domestication of the banteng has been of comparatively

* This appears to be Prof. Ewart's opinion (P. Z. S. 1911, i. p. 281). In concluding his study of the skulls of Roman cattle obtained at Newstead, he wrote:—"Hence it may be said that up to at least the Bronze Age the majority of the domestic cattle of Europe were the descendants of *Bos primigenius*—some being nearly pure descendants of the imported 'Celtic' shorthorn breed, while others were pure or nearly pure descendants of the indigenous wild urus (*Bos taurus primigenius*)." But since he assumes it to be probable that the "Celtic" shorthorn was itself a domesticated dwarfed descendant of an Asiatic variety of *Bos primigenius*, there is clearly only one wild species involved in the ancestry. The evidence which excludes other breeds of cattle from this genealogy does not appeal to me as at all convincing.

short duration. It may not indeed date back beyond the Dutch occupation of Java in the seventeenth century.

In the second place, the theory seems to me to be inadequately supported on the zoological side. Judging from the banteng I have seen, I should say there is nothing distinctly zebu-like about them except the sloping croup and the sexual dimorphism in colour. Apart from these characters, which I suspect are primitive in the Bovinæ (*cf. infra*, p. 108), banteng exhibit no noticeable resemblances to zebus, except such as are shared by many European cattle above suspicion of zebu blood in their veins. Banteng, indeed, are remarkably "taurine" in style apart from their white stockings, white rumps, elevated withers, and the roughness of the naked skin of the intercornual area in adult bulls. And these characters, be it noted, also differentiate them from zebus, which, in my experience of many individuals of the best-defined breeds, never show a trace of them. This is not what one would expect if the theory of the relationship between the two types were sound. Mr. Lydekker certainly suggests that the white fetlock-rings seen in some zebus may be the remains of the white stockings in the banteng; but whatever be the value of this suggestion, it is discounted in the question at issue by the presence of this ring in some English park cattle claimed to be of pure aurochs descent.

Mr. Lydekker also attempts to explain the hump so characteristic of zebus as the concentrated remains of the tissue covering in the banteng the high spinous processes of the thoracic vertebræ, suggesting that it was left behind, so to speak, when according to the theory these bony processes became reduced during the evolution of the zebu from that species. I do not think this theory of the origin of the hump need be discussed until the supposition upon which it rests, that the vertebræ in question have been shortened, is supported by more evidence than is at present forthcoming. For myself, I should be inclined to compare the hump of the zebu to the accumulation of tissue which may be seen just in front of the withers in many well-fed European bulls (see, for example, pl. xiii. of Mr. Lydekker's volume), and which was quite perceptible in a bull banteng recently exhibited in the Zoological Gardens. However that may be, it cannot in my opinion be seriously claimed that the hump of the zebu and the elevated dorsal crest of the banteng are evidence of affinity between the two. The external appearance of the animals, in short, affords no support to the view that the banteng is the ancestor of the zebu.

It may be recalled that the difference in voice between

B. indicus and *B. taurus* has been frequently advanced as evidence of their specific distinctness. To this I shall refer later (p. 109). If there is any truth in the claim, the argument disposes of the theory of the banteng descent of the zebu. The voice of the zebu I have described below. It differs considerably from that of the banteng, which I have heard described as a roar or bellow. Perhaps Blanford's phraseology applied to the voice of the gaur will convey as good an idea of it as any. He said it is "a prolonged call, not very unlike the lowing of *Bos taurus*, but utterly unlike that of *B. indicus*." Blanford, however, seems to have been unacquainted with the true call of the zebu (*cf. infra*, p. 109). In my opinion, the voice of the zebu differs at least as much from the voice of the banteng as it does from that of *B. taurus*; but for reasons given below I do not think this necessarily disproves the theory of the descent of the zebu from the banteng.

The evidence derived by Rüttimeyer from the form of the skull in the banteng and zebu is rendered, in my opinion, untrustworthy by the extraordinary variability of the skull in domesticated cattle. In any case, the cranial resemblances between the two are not close, as a comparison between Lydekker's figure of the skull of a bull Gujrati zebu (published on pl. xx. of his volume on the Ox) with his figures of the skulls of the Javan and Bornean banteng (published on pp. 24 & 26 of his 'Catalogue of Ungulates' in 1913) will show. The banteng-skulls, indeed, have a relatively longer forehead and shorter face, and thus approximate to the typical taurine type. Nevertheless, the skull is so plastic that I should hesitate to take it as a reliable guide to affinity, one way or the other, where domesticated animals are concerned (*cf. infra*, p. 106).

One other point may be referred to. In both the gayal and the banteng, representing two distinct species of the *Bibos* group of cattle, the urethral canal of the penis ends in a small pointed process, free from the swollen termination of the glans. In the zebu there is no such process, the urethral canal terminating, as in typical *Bos*, on the underside of the swollen end of the glans (Ann. & Mag. Nat. Hist. (9) ii. pp. 451, 454-455, 1918).

III. THE CHARACTERS OF *BOS INDICUS* AND *BOS TAURUS*.

The principal differences between an average Indian zebu and an average British or Spanish fighting bull are well known. The zebu has a hump of fleshy and fatty tissue on

the front of the withers, a more sloping croup, a heavier dewlap, a longer narrower skull with relatively shorter frontal and longer nasal maxillary region, and horns which are more upright in direction of growth. The European animal, on the contrary, has no hump, the plane of the croup is in a line with the back, the dewlap is shallower, the skull shorter but with its frontal portion relatively longer, and the horns are more horizontal in direction of growth. The voices of the two also are different, but not so different as literature would lead one to suppose. Habits and constitution supply further differences.

If there were no other types of domesticated cattle in existence there would be grounds for the opinion of Blyth and others as to the specific distinctness of the two types. But when the differences are analyzed they appear to me to lose much of their weight. Even amongst undoubted Indian zebus there is immense variation in most of the characters mentioned, the hump alone, so far as I am aware, forming an exception. The characters may be considered in order:—

Horns.—Of the horns of the zebu Lydekker (pp. 132–133) wrote:—“The horns of all humped cattle—both Indian and African—differ from those of the aurochs and the related types of European domesticated cattle by their distinctly lyrate shape, the first main curve having the convexity in front instead of behind. Their tendency is also to grow upwards and backwards rather than forwards.” This statement is untrue. In the first place, the horns of Heberstein’s aurochs (pl. iii.) are very like those of the Gujrati zebu (pl. xx.) in direction and curvature. In the second place, the horns of zebus are so variable that it is impossible to affirm anything definite with regard to them. From the type above described by Lydekker from the Gujrati breed the horns may deviate by taking a horizontal direction sideways or a horizontal and forward curvature or a downward inclination. Most curious of all is the type seen in the Mysore breed, here the horns arise close together on the top of the head and recede backwards and upwards, the whole of the anterior surface being concave. In the calf, indeed, they begin as erect buds, not as lateral horizontal buds as in the Gujrati. With regard to the question at issue, the point to be noticed is that the Mysore zebu differs more from the short-horned zebu in the position and curvature of the horns than the short-horned zebu differs from short-horned British cattle. Yet no one supposes these zebus to be other than domesticated breeds of one and the same species.

In European cattle, even setting aside for the moment

those breeds claimed to be of partial zebu descent from the shape of their horns, great variation in these appendages is met with. In any considerable herd of "shorthorn" the horns may be elevated, depressed, or horizontal; and in closely related breeds like the Chartley and Chillingham park cattle the horns differ greatly, being long and downturned in the Chartley and shorter and upturned in the Chillingham (see Lydekker, pl. iv.). Yet in spite of these differences the one breed, I take it, has as much claim as the other to be regarded as a pure-bred representative of *B. taurus*. Apart from the qualification, I entirely agree with Prof. Ewart's dictum (P. Z. S. 1911, pl. i. p. 272):—"Except when they curve forwards at right angles to the frontals, as in typical Celtic shorthorns, the horns assist but little in settling the race to which the Newstead skulls belong." I am not, however, sure whether the term "race" is used in this connection to signify artificially formed "breeds" or natural "species" or "subspecies."

Skull.—As stated above, the skulls of typical zebus differ from the skulls of European cattle of assumed purity of descent from the aurochs in having the frontal region of the skull shorter and the naso-maxillary region longer, coupled with orbits which are less prominent. Although importance has been attached to these points in the attempt to prove specific diversity between the two types, it is surely a matter of common knowledge that, in some domesticated mammals at least, no part of the skeleton is so plastic and subject to such profound variation in structure as the skull. This is well shown in dogs and almost equally well in cattle. One instance only need be cited in support of this statement. Speaking of the Niata or Nata breed of La Plata, Darwin remarked that "on comparison with the skull of a common ox, scarcely a single bone [of the skull] presents the same exact shape, and the whole skull has a wonderfully different appearance." It is needless to mention all the peculiarities described by Darwin and Owen, the most remarkable being the upward curvature of the jaws, the short broad forehead, the extremely abbreviated nasal bones, and the union between the premaxillæ and the lacrymals. These cattle breed true to type, and the interesting thing about them is that the breed must have originated since 1552, when cattle were first introduced into South America. Here, then, we have a clear case of the formation from ordinary European cattle of a type differing from them most profoundly in the structure of the skull. With this proof of the potential variability of the bones of the cranium in European cattle before us, what

justification have we for assuming that the comparatively slight differences between the skulls of European cattle and humped cattle indicate initial specific distinctness between these two? Obviously very little.

The unsatisfactory nature of the evidence supplied by skulls and horns, is attested by the variety of opinions held by authors who have attempted to solve the difficult question of the origins of domesticated breeds of cattle, by relying largely on characters furnished by the cranium and its appendages.

Dewlap.—The dewlap in zebu is often heavier and deeper and sometimes rises nearer the chin* than in European cattle believed to be of unmixed aurochs descent. I cannot satisfy myself as to the precise value attached to this feature by Lydekker. He quotes it as characteristic of zebu, when contrasting them with the European breeds of the aforesaid type, and more than once cites it as evidence of zebu blood in those European breeds that reproduce the character. But a precisely similar difference in the development of the dewlap exists between the domesticated gayal and the wild gaur; yet in this case (pp. 149 & 177) Lydekker uses this difference to support the view that the gayal is nothing but a domesticated race of the gaur, and ascribes the larger size of the dewlap in the former to the effect of domestication, adding “the excessive development of the dewlap in the humped cattle of India is perhaps also the result of domestication.” I quite agree with this view, but it clearly disposes of the claim that the larger size of the dewlap in zebu is evidence of their specific distinctness from pure-bred European cattle.

Ears.—Blyth stated that the ears of *B. indicus* differ from those of *B. taurus* in shape, being more pointed. In a general way this is perhaps true; but no zebu that I have seen has ears approaching in apical attenuation those of the Hungarian cow depicted by Lydekker on pl. xv. Even amongst zebu themselves the ears differ so much in size and shape, as may be seen by comparing those of the Gujrati and Mysore breeds (pl. xvii.), that no reliance can be placed on these organs as evidence of specific distinctness between zebu and normal European cattle.

Croup.—Although zebu typically have a sloping croup, and never, within my experience, a horizontal croup like that of European cattle, nevertheless the differences between zebu

* Many of Lydekker's figures illustrating breeds of European cattle show the anterior lobe of the dewlap in the interramal area behind the chin, as in zebu.

in this particular is very great, as is shown by the Mysore and Gujrati breeds represented on pl. xvii. The Gujrati zebu, indeed, has a croup very sensibly approaching that of European cattle in its elevation.

Colour.—One or two colour-characters are mentioned by Lydekker as evidence of specific distinctness between *B. taurus* and *B. indicus*. He speaks of white rings round the eyes and fetlocks as characteristic of the zebu. But since such typical examples of *B. taurus* as park cattle by no means infrequently have white rings round the fetlocks, and since the hair round the eyes in Jerseys, which are beyond suspicion of zebu blood, should, as Lydekker says (p. 115), be cream-coloured or greyish, it is quite clear that no value can be attached to these points. Again, the presence of a light spinal stripe in Kerry cattle (p. 95) in the Craven breed of longhorns (p. 84) and in Castilian bulls (p. 132) is quoted as certain evidence of aurochs descent. Very likely that is the case. But a white spinal stripe is not uncommonly present in pure-bred zebus. Hence if this character has the significance claimed for it by Lydekker, it is evidence of consanguinity between *B. taurus* and *B. indicus*.

Finally, in the tendency exhibited by bull banteng to become black, and thus depart from the rufous tint of cows and young bulls, Lydekker sees the origin of the sexual difference in colour between some breeds of zebu, the cows of which are whitish while the bulls are blackish or iron-grey*. But traditional information about the aurochs suggests that that species also was sexually dimorphic in colour. One aurochs indeed was recorded as grey—presumably, that is to say, zebu-like. Hence the colour-difference between the sexes of zebus cannot be claimed with assurance as a banteng character. So far as it goes, indeed, it suggests closer affinity between the zebus and the aurochs than between the latter and typical breeds of *Bos taurus*, in which the sexes are, I believe, alike. But I am not prepared to lay any great stress upon this point, because, as stated above, I suspect sexual dimorphism of colour in cattle to be a primitive character inherited from a Tragelaphine ancestor †. How-

* Bull calves of the Mysore and Gujrati breeds begin to darken in the first year.

† Lydekker (pp. 32-33 & 253) appears to have been attracted by Prof. Lönnberg's view that cattle are closely related to the gnus (*Connocheetes*). He adds, however, that although the direct ancestry of the ox tribe is still unknown, the earliest representatives of the group are related to the buffaloes, which constitute in some respects the most primitive of

ever that may be, it may be claimed that the coloration of zebus and European cattle affords no support to the view that they belong to distinct species.

Voice.—Blyth and those who have copied him attach great importance to the voice as a criterion of distinct specific origin between *B. indicus* and *B. taurus*. He and Blanford described the voice of the former as a grunt utterly unlike the “lowing” or bellowing of European domesticated cattle. This is only half the truth. Zebus, on the whole, are silent animals, but now and again they utter an abbreviated or prolonged grunt recalling that of a yak or American bison. But they also call with a loud voice which may be perhaps described as somewhat intermediate between the “moo” of an ordinary cow and the hoarse “baa” of a sheep. The sound is distinguishable from that of a cow or bull of British cattle, but I have heard a zebu calf, fretting for its mother, call her with a voice very like that of an English “shorthorn” calf.

The voice is certainly a criterion of kinship in wild animals; but to what extent it is to be trusted in domesticated forms appears to me to be doubtful. It is admitted, I take it, that domesticated fowls are the unmixed descendants of the Bankiva jungle-fowl (*Gallus gallus*). Nevertheless, the crow of the latter is generally, within my experience, distinguishable from that of the former, though unmistakably like it: and different breeds of domesticated fowls often differ to a certain extent in voice, thus attesting the variability, though limited, of this character. Domesticated dogs, too, differ from wolves in having added the bark to the howling voice common to both; yet the wolf or the jackal—it matters not which in the present connection—is usually accepted as the

the living forms and are those whose horns come nearest in shape to those of gnus. This author's reliance on the shapes of horns as tests of affinity led him into few more unintelligible errors than this, excepting only his employment of the curvature of the horns, a manifestly useless character for the purpose, as a basis for the classification of the Bovidæ in his ‘Catalogue of Ungulates.’ With all respect to Prof. Lönningberg, I am quite sure that his opinion about *Comochates* and *Bos* is unsound. The anatomical evidence that gnus are specialized hartebeests (*Bubalis*) and that the cattle are specialized Tragelaphines appears to me to be conclusive. The view that close affinity between the Bovines and Tragelaphines, attested more particularly by the Anoa, the primitive Asiatic buffalo, is quite in keeping with Lydekker's above-quoted statement that the earliest representatives of the ox-tribe are related to the buffaloes, which in some respects are the most primitive of living forms of Bovinæ.

wild prototype of the dog. Moreover, pure-bred dingoes and some Eskimo dogs, I am told, never bark. But no one believes them on that account to be specifically distinct from dogs which habitually bark. For these reasons I do not think the differences between the voices of *B. indicus* and *B. taurus* can be held as proof of specific difference between them, and the same concession must be made in the case of the claim of the banteng descent of *B. indicus*.

Habits.—Blyth pointed out that humped cattle in India differ from ordinary European cattle in that they never seek shade and never go into water and stand there knee-deep. Lydekker (p. 150) quotes this passage in his endorsement of Blyth's opinion that the zebu is of different specific descent from European cattle; but his acceptance of the theory that zebu are domesticated forms of the banteng involves the conclusion that an equally great change in habits has taken place, the banteng being a forest-dweller like its ally the gaur. Moreover, when discussing (p. 89) Professor Hughes's denial that British park cattle were derived from an ancestor which dwelt in forests, he admits that the habits of domesticated cattle have varied to some extent from those of their wild ancestors. This admission is founded on the known habit of park cattle of lying out in the open during periods of repose, coupled with the assumption that the aurochs (*B. primigenius*) resembled the gaur in seeking shade. Although the truth of this assumption cannot, in my opinion, be granted, considering that the gaur is a tropical Indian species, whereas the aurochs inhabited temperate latitudes in Europe and Asia, Lydekker's opinion that a change of habit has taken place in park cattle deprives of its value his support of Blyth's claim that the further change in the case of the zebu is evidence of specific difference of origin*.

The zebu's avoidance of water may perhaps be explained, without reference to specific ancestral traits, by its being originally, at all events, a breed raised for survival in hot desert countries where water was periodically scarce, and where in times of drought and shortage of food the hump was useful for the sustenance it supplied. In specimens kept on

* An interesting case attesting variation in habits and instincts of park cattle was reported to me some years ago. The Zoological Society sent a bull and a cow of a mixed Vaynol and Chartley breed to Calcutta. The bull soon died from exposure to the sun, disregarding the shade of a tree in the enclosure. The cow, having the instinct to avail herself of the shelter, survived.

short rations the hump soon begins to dwindle and sag like that of a camel. Prof. Ewart has, I believe, suggested a similar explanation for the accumulations of fat on the rump and tail of some breeds of domesticated sheep.

The constitutional difference between zebus and British cattle, shown by the capacity of the former to withstand the climatic and other conditions even of Brazil and Jamaica, to which British cattle succumb, is precisely what one would expect in the case of two breeds adapted for generations to such widely different physical conditions as are supplied, on the one hand, by tropical India, and, on the other, by temperate Europe.

Blyth maintained that zebus differ from European cattle in their habitual method of carrying the head when at rest. This is quite true of some breeds; Gujrati zebus, for example, hold the head somewhat elevated and not in a line with the spine in the attitude characteristic of *Bos taurus*. The splendid appearance of this breed of zebus, indeed, is due to that circumstance, and, when they are startled, to the alert stag-like lift of the head so different from the slouching carriage observable in other cattle. But Blyth's claim does not apply to all breeds. Mysore zebus, for instance, stand with the head depressed very much as in ordinary cattle. These differences between the two breeds of zebus are well illustrated on pl. xvii. of Lydekker's book, showing a Mysore cow in repose and a Gujrati bull standing at attention.

So far, then, as habits are concerned, there appear to me to be no difficulties in the way of believing in the common origin of *B. taurus* and *B. indicus*.

IV. EUROPEAN AND EGYPTIAN CATTLE OF SUPPOSED ZEBU DESCENT.

Most writers who have written on the subject find evidence of zebu blood in many breeds of cattle of Southern and Central Europe, the character of the horns forming the principal criterion. This claim may be perfectly true, but the testimony produced in its support is by no means convincing. Take, for example, the Transylvanian bull illustrated on pl. i. of Lydekker's book. This beast has the long body, straight back, high croup, long forehead covered with curly hair, short naso-maxillary region in the skull, and short thick legs wrapt up in one's conception of British shorthorns and park bulls. A comparison between the figure

in question and that of the Vaynol bull on pl. v. bears out this contention. The dewlap of the Transylvanian bull is a little deeper, it is true, but it is not appreciably deeper than in the Swiss and Simmenthal bulls, without claim to zebu blood, depicted on pl. xiii. The only striking difference between the Vaynol and the Transylvanian bulls lies in the horns, which in the latter are much longer and extend at first horizontally outwards and then upwards; but they are not like the horns of any Indian zebu I have seen, and differ no more, perhaps less, from the upturned horns of the Chillingham breed than the latter differ from the downturned horns of the Chartley breed shown on pl. iv. Hence it appears to me that the evidence of zebu blood in the Transylvanian bull is quite untrustworthy; and if the head of this animal be compared with the skull of the Spanish draught ox (pl. xiv.), another breed of assumed zebu descent, it will be evident that, so far as the head and horns are concerned, the two breeds are very much alike. The assumption that the Spanish draught cattle are wholly or partly zebus, in which the hump has been eliminated by selective breeding or crossing, seems to me inadequately supported by the facts.

The same theory has been put forward to explain the zebu descent of some of the humpless cattle of ancient Egypt, and to illustrate the characters of these cattle Lydekker reproduces two figures from Egyptian monuments—one (p. 135) showing four cows, the other a bull (pl. xvi.),—which in general style resemble the Transylvanian bull aforesaid, and are believed by Dürst and Lydekker to belong to the same stock and to have been introduced into Spain. That the Egyptian cattle belong to the same stock as the Spanish may be admitted, on the evidence, as probable, and that they were introduced into Spain as possible; but since they have the long bodies, humpless withers, high croup, and shallow dewlap of typical examples of *Bos taurus*, the claim that they are zebus with the hump artificially suppressed is surely unwarranted. At all events, the identification of these cattle must be admitted to be a matter of doubt. If they are not zebus, as I maintain, what becomes of the theory that their supposed introduction into Spain by the Moors or other invaders supplies the explanation of the alleged zebu blood in Spanish draught cattle?

I find similar difficulties in agreeing with Lydekker's determination of the Nineveh bull, depicted on p. 64, which he says appears to be an aurochs despite the absence of the mane and the excessive length of the tail. The animal,

however, has a collar on the neck suspiciously suggestive of domestication. It may be noticed, too, that the elevated carriage of the head recalls that of the Gujrati zebu shown on pl. xvii. Lydekker also remarks, in connection with this supposed aurochs, that it is "quite unlike the figure of the ancient Assyrian humped ox" reproduced on p. 140 of his book. Of these he wrote:—"In the contour of the neck and shoulders, as well as in the direction of the horns, the representations of these humped cattle differ widely from those apparently representing the aurochs (p. 64). That these long-horned cattle did not come from Egypt is demonstrated by the presence of the well-developed hump, but the horns are of the Egyptian type."

I cannot in any way reconcile these statements with the facts. The figure shows a pair of heavily built, short-bodied, long-legged oxen, with high carriage of the head. The animal in the foreground is polled, and has a very poorly, not a well-developed hump. It might pass for a polled zebu with an incipient hump, although the dewlap is absent, instead of being well grown as it is in that breed. The animal in the background, mostly hidden by its companion, has stout horns of medium length, which, instead of resembling, as alleged, those of the Egyptian cattle in their upward trend, are turned horizontally forwards in a line with the back, the point only being hooked upwards, almost exactly as in the figure of the Augsburg aurochs (pl. iii.). These horns appear to me to differ in no important respect from those of the supposed Assyrian aurochs, except that they are a little longer. The hump is not shown in the illustration; hence, if present, it was not larger than that of the ox in the foreground. Granting the presence of a small hump, it may be maintained that in that particular only does the horned bull of the pair in question, believed to be a zebu, differ from the above-quoted Nineveh bull, believed to be an aurochs.

If Lydekker's identification of these two Assyrian bulls be correct, it seems to me that the conclusion derived therefrom is precisely the opposite of that which he maintains, in the sense that the case supplies very strong evidence of the aurochs descent of the zebu. But apart from allowing that these Assyrian sculptures furnish interesting evidence of the existence of domesticated cattle approaching the zebu-type in many particulars in Mesopotamia at an early historic period, I do not think very great reliance should be placed upon structural details in mouldings apparently largely conventional. My purpose in referring to these and other cases

discussed in this section, is to show that the diversity of interpretation of which they are susceptible weakens the force of the contention that European breeds of cattle are of dual specific origin.

V. CONCLUSIONS.

1. Indian humped cattle (*Bos indicus*) are not descended from the banteng (*Bibos banteng*), but from some species of *Bos*, to which genus, or subgenus, they belong.
2. They intergrade in almost all characters with *Bos taurus*. Such differences as typical representatives of the two breeds exhibit are quite compatible with the view of their descent from a common ancestor, probably the aurochs (*B. primigenius*); but zebus may be the descendants of a form of *Bos* differing subspecifically, perhaps specifically, from *B. primigenius*, but closely related thereto. Nevertheless, if that be so, the extreme differences between *B. taurus* and *B. indicus* are not traceable to original ancestral differences, but are the product of long-enduring domestication, under widely distinct physical conditions, coupled with selective breeding along divergent lines guided by different tastes and needs*.
3. The claim that some European cattle have an admixture, small or great, of zebu blood, due to the human introduction of that stock into Southern Europe is not established by the facts adduced in its support. It may, however, be true. On the other hand, the alleged zebu characters of such cattle may be explained, if the allegation be sound, by their representing stages in the evolution of the zebu type from *Bos primigenius*.

* Although the conclusion that *B. taurus* and *B. indicus* had a common ancestor or are possibly the descendants of two closely allied forms of *Bos* has been reached by the analysis of a different class of facts, it seems to coincide with that of several modern students of the group. Prof. Ewart, for example (P. Z. S. 1911, pt. ii. p. 281, footnote), thinks it probable that the long-browed short-horned zebus are probably representatives of the small domesticated ox of Anau, the so-called Celtic shorthorn, itself of aurochs descent. Perhaps the settlement of the disputed relationship between *Bos namadicus*, the so-called Asiatic aurochs, and *Bos primigenius*, the European aurochs, which was apparently also of Asiatic origin, may supply an answer to the still doubtful question as to whether the domesticated cattle discussed in this paper trace their descent from two distinct species of *Bos* or from two local races of a single species.